

Head injury

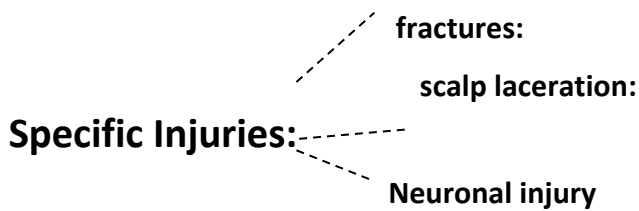
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Epidemiology:

- M: F= 2-3:1

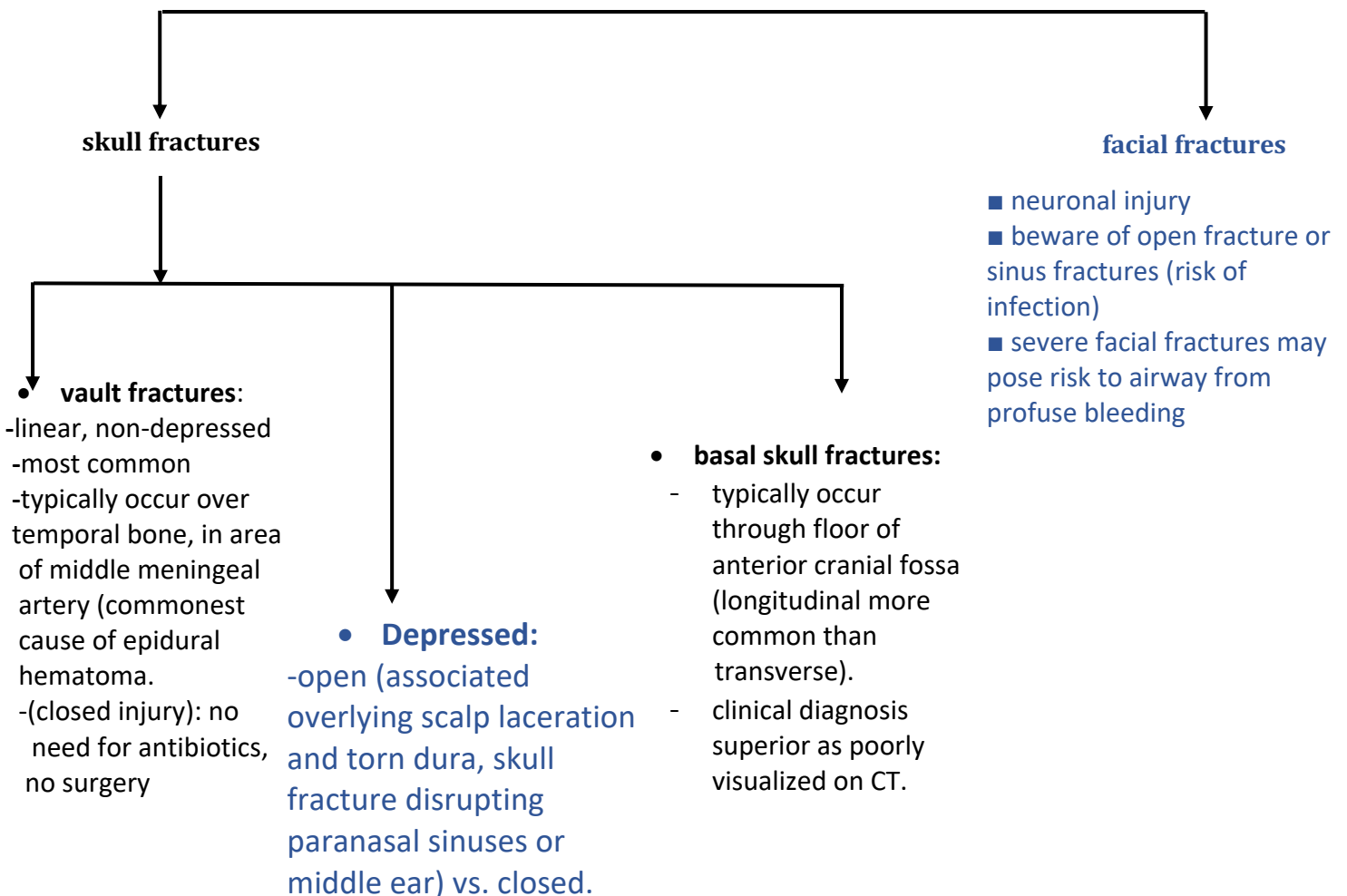
Pathogenesis:

- acceleration/deceleration: contusions, subdural hematoma, axon and vessel shearing/mesencephalic hematoma.
- impact: skull fracture, concussion, epidural hematoma
- penetrating: worse with high velocity and/or high missile mass:
 - low velocity: highest damage to structures on entry/exit path.
 - High velocity: highest damage away from missile tract.
 - 60% of MVC-related deaths are due to HI



1- fractures:

Dx: non-contrast head CT and physical exam



2- scalp laceration:

- can be a source of significant bleeding.
- achieve hemostasis, inspect and palpate for skull bone defects \pm CT head (rule-out skull fracture).

3- Neuronal injury:

1- diffuse

A- mild TBI = concussion:

- transient alteration in mental status that may involve loss of consciousness
- hallmarks of concussion: confusion and amnesia, which may occur immediately after the trauma or minutes later
- loss of consciousness (if present) must be less than 30 min, initial GCS must be between 13-15, and post-traumatic amnesia must be less than 24 h

B- diffuse axonal injury

- ◆ mild: coma 6-24 h, possibly lasting deficit
- ◆ moderate: coma >24 h, little or no signs of brainstem dysfunction
- ◆ severe: coma >24 h, frequent signs of brainstem dysfunction

2- focal

- contusions
- intracranial hemorrhage (epidural, subdural, intracerebral)

Every Patient with One or More of the Following Signs or Symptoms should be Placed in a C-Spine Collar:

- Midline tenderness
- Neurological symptoms or signs
- Significant distracting injuries
- HI
- Intoxication
- Dangerous mechanism
- History of altered LOC

Warning Signs of Severe Head Injury

- GCS <8
 - Deteriorating GCS
 - Unequal pupils
 - Lateralizing signs
- N.B. Altered LOC is a hallmark of brain injury

ASSESSMENT OF BRAIN INJURY:

1- History:

- pre-hospital status.
- mechanism of injury.

2- Physical Exam:

- assume C-spine injury until ruled out
- vital signs:
 - shock (not likely due to isolated brain injury, except in infants)
 - Cushing's response to increasing ICP (bradycardia, HTN, irregular respirations)

- **severity of injury determined by:**

1. LOC

◆ GCS ≤ 8 intubate, any change in score of 3 or more = serious injury

◆ mild TBI = 13-15, moderate = 9-12, severe = 3-8

2. pupils: size anisocoria >1 mm (in patient with altered LOC), response to light.

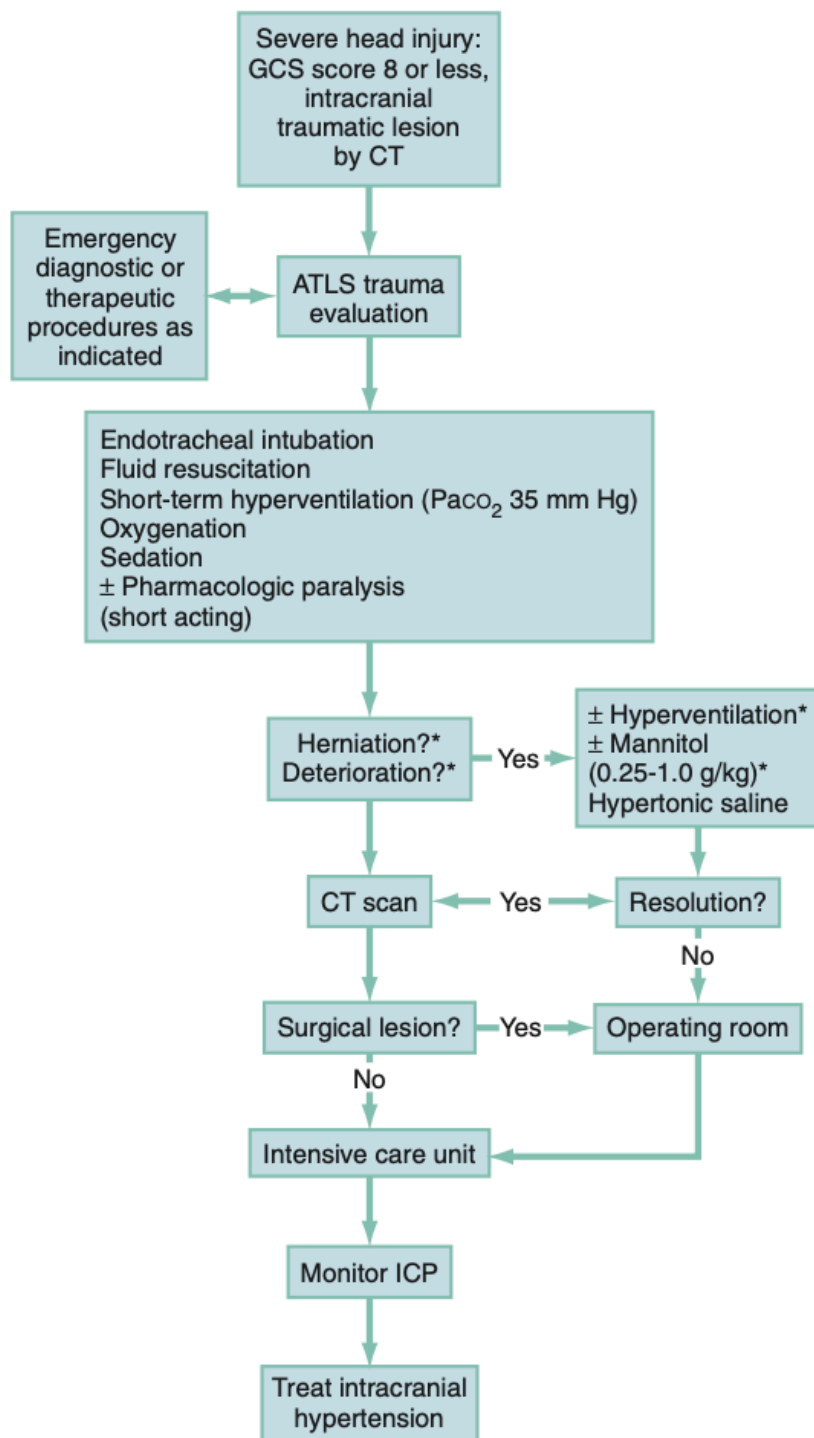
3. lateralizing signs (motor/sensory)

◆ may become subtler with increasing severity of injury.

- reassess frequently.

3- Investigations:

- labs: CBC, electrolytes, PT/PTT or INR/PTT, glucose, toxicology screen.
- CT scan head and neck (non-contrast) to exclude intracranial hemorrhage/ hematoma.
- C-spine imaging.



*Only in the presence of signs of herniation or progressive neurologic deterioration not attributable to extracranial factors.

Figure 41-6. Initial resuscitation of patient with severe head injury: treatment options. *ATLS*, advanced trauma life support; *CT*, computed tomography; *GCS*, Glasgow Coma Scale; *ICP*, intracranial pressure; *Paco₂*, arterial carbon dioxide partial pressure. (From the Brain Trauma Foundation, American Association of Neurological Surgeons, Joint Section on Neurotrauma and Critical Care: Introduction. Guidelines for the management of severe traumatic brain injury. *J Neurotrauma* 17:465, 2000.)

Management

• **goal in ED: reduce secondary injury by avoiding hypoxia, Ischemia, decreased CPP, seizure.**

- **general**

- ABCs
- ensure oxygen delivery to brain through intubation and prevent hypercarbia
- maintain BP (sBP>90)
- treat other injuries.
- Give IV antibiotics for patients with compound skull fractures. Cefuroxime 1.5g IV is a suitable choice, but be guided by local policy. Regional neurosurgical centres vary as to whether or not they advise prophylactic antibiotics for clinical base of skull fracture (there is no compelling evidence that they prevent meningitis): follow local policy.

- **early neurosurgical consultation for acute and subsequent patient management**

- **seizure treatment/prophylaxis:**

- benzodiazepines, phenytoin, phenobarbital.
- steroids are of no proven value.

- **treat suspected raised ICP, consider if HI with signs of increased ICP:**

- intubate.
- calm (sedate) if risk for high airway pressures or agitation.
- paralyze if agitated.
- hyperventilate (100% O₂) to a pCO₂ of 30-35 mmHg.
- elevate head of bed to 20°.
- adequate BP to ensure good cerebral perfusion.
- diurese with mannitol 1g/kg infused rapidly (contraindicated in shock/renal failure).

- **Disposition**

- neurosurgical ICU admission for severe HI.
- In hemodynamically unstable patient with other injuries, prioritize most life-threatening injuries and maintain cerebral perfusion.
- For minor HI not requiring admission, provide 24h HI protocol to competent caregiver, follow-up with neurology as even seemingly minor HI may cause lasting deficits.

Mild Traumatic Brain Injury:

Epidemiology:

- TBI results in 1.7million deaths, hospitalizations, and ED visits each year (US)
- 75% are estimated to be mild TBI; remainder are moderate or severe
- highest rates in children 0-4yr, adolescents 15-19yr, and elderly >65yr.

Clinical Features:

- **somatic:** headache, sleep disturbance, N/V, blurred vision.
- **cognitive dysfunction:** attentional impairment, reduced processing speed, drowsiness, amnesia
- **emotion and behaviour:** impulsivity, irritability, depression
- **severe concussion:** may precipitate seizure, bradycardia, hypotension, sluggish pupils.

Etiology

- falls, MVC, struck by an object, assault, sports.

Investigations:

- neurological exam.
- concussion recognition tool.
- imaging CT as per Canadian CT Head Rules, or MRI if worsening symptoms despite normal CT.

CT Head is only required for patients with minor head injuries with any one of the following High Risk (for neurological intervention):

- GCS score <15 at 2 h after injury.
- Suspected open or depressed skull fracture.
- Any sign of basal skull fracture (hemotympanum, "raccoon" eyes, cerebrospinal fluid otorrhea/ rhinorrhoea, Battle's sign)
- Vomiting ≥ 2 episodes
- Age ≥ 65 y

Medium Risk (for brain injury on CT) :

Amnesia after impact > 30min.

Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height > 3 feet or five stairs).

Minor Head Injury is defined as :

witnessed loss of consciousness,
definite amnesia, or

witnessed disorientation in a patient with a GCS score of 13-15.

Treatment:

- close observation and follow up; for patients at risk of intracranial complications, give appropriate discharge instructions to patient and family; watch for changes to clinical features above, and if change, return to ED.

Treatment for Minor Head Injury (GCS 13-15)

- observation over 24-48h.
- wake every hour.
- judicious use of sedatives or painkillers during monitoring period.
- outpatient: advise patients to undergo stepwise approach to return to play and return to school.

Treatment for Severe Head Injury (GCS ≤ 8):

- clear airway and ensure breathing (if GCS ≤ 8 , intubate)
- secure C-spine.
- maintain adequate BP.
- monitor for clinical deterioration.
- monitor and manage increased ICP if present.

Admission required if:

- skull fracture (indirect signs of basal skull fracture).
- confusion, impaired consciousness, concussion with > 5min amnesia.
 - focal neurological signs, extreme H/A, vomiting, seizures.
 - unstable spine.
 - use of alcohol.
 - poor social support.

- Hospitalization with normal CT (GCS<15, seizures, bleeding diathesis), or with abnormal CT
- Early rehabilitation to maximize outcomes.
- Pharmacological management of pain, depression, headache.
- follow Return to Play guidelines.

Prognosis:

- most recover with minimal treatment.
athletes with previous concussion are at increased risk of cumulative brain injury
- Repeat TBI can lead to life-threatening cerebral edema or permanent impairment.

Cranial Nerve Injury:

• **most traumatic causes of cranial nerve injury do not warrant surgical intervention**

• surgical intervention:

- CN II: local eye/orbit injury
- CN III, IV, VI: if herniation secondary to mass
- CN VIII: repair of ossicles.

• CN injuries that improve:

- CN I: recovery may occur in a few months; most do not improve
- CN III, IV, VI: majority recover
- CN VII: recovery with delayed lesions
- CN VIII: vestibular symptoms improve over weeks, deafness usually permanent (except when resulting from hemotympanum)

Late Complications of Head/Brain Injury:

- seizures: 5% of head injury patients develop seizures
 - A- incidence related to severity and location of injury (increased with local brain damage or intracranial hemorrhage).
 - B- post-traumatic seizure may be immediate, early, or late
 - C- presence of early (within first wk) post-traumatic seizure raises incidence of late seizures.
- meningitis: associated with CSF leak from nose or ear.
- hydrocephalus: acute hydrocephalus or delayed normal pressure hydrocephalus (NPH)
- Post-Concussion Syndrome (PCS)/neuro-psychiatric effects.

Brain Injury Outcomes:

- mildly traumatic (GCS13-15): post- concussive symptoms: H/A, fatigue, dizziness, nausea, blurred vision, diplopia, memory impairment, tinnitus, irritability, low concentration; 50% at 6 wk, 14% at 1 yr.
- moderately traumatic (GCS 9-12): proportional to age (>40) and CT findings; 60% good recovery 26% moderately disabled, 7% severely disabled 7% vegetative/dead.
- Severe (GCS≤8): difficult to predict, correlates with post resuscitation GCS (especially motor) and age.